1.0 SITE CHARACTERIZATION AND MONITORING

If the initial site inventory and reconnaissance reveals that additional site characterization is required, choose the applicable baseline studies given below, fill-in the blanks, and total the costs.

The given costs are typical for mine sites with insignificant to moderate environmental impacts. Keep in mind that costs could be 5 to 10 times the given costs where a site has significant impacts on the environment.

In this worksheet:

* A small site is an isolated mine with less than 2.5 acres of disturbed area (typically a 19th century underground mine.
* A medium site has up to 200 acres of disturbed area (historic mining districts, modern underground mines and small quarries).
* A large site is greater than 200 acres (modern open pit and strip mines).

Cost

1.1 Geology.

From above definition of site sizes, select one of the following cost estimates:

Small	Medium	Large	
$2,000	$10,000	$50,000	_____.

1.2 Soil and mine wastes.

Estimate area of disturbed land:

(_____ acres x $100/acre) = _____.

If unstable ground (hillslopes, dumps, mine openings) is suspected, add $15,000. _____.

1.3 Surface water.

Determine monitoring sites and number of samples per year (typically 3 - 7 times):

(_____ sites x ____ samples/yr x $1,000/sample) = _____.

1.4 Groundwater.

Estimate depth of groundwater.

Space monitoring wells 500 ft apart down gradient from disturbed area and add one up gradient well.

(_____ wells x _____ ft/well x $20/ft) = _____.

(_____ wells x ____ samples/yr x $1,000/sample) = _____.

If a pump test is required, add $50,000. _____.

1.5 Air quality.

A requirement for air sampling is most unlikely unless the site is a large strip mine, open pit, or tailings impoundment. If so, add the cost of a meteorological station and the cost of operation, analysis, and reporting at $150,000.

_____.

1.5 Vegetation.

Estimate size of study area:

(_____ acres x $25/acre) = _____.

1.6 Wildlife.

From above definition of site sizes, select one of the following cost estimates:

Small	Medium	Large	
$3,000	$5,000	$15,000	_____.

If endangered species are suspected to be present, add $10,000. _____.

1.7 Historical and cultural.

From above definition of site sizes, select one of the following cost estimates:

Small	Medium	Large	
$1,000	$5,000	$5,000	_____.

If items of historical/cultural relevance exist, add $15,000. _____.

1.8 Permitting and NEPA compliance.

If site is not covered by a programmatic EIS and project must comply with local permitting

requirements, add the cost of compiling baseline information and preparing an environmental assessment:

Small	Medium	Large	
$6,000	$12,000	$20,000	_____.

If the site requires an EA or EIS, add the cost as applicable:

Small	Medium	Large	
$15,000	$30,000	$70,000	_____.

TOTAL -------> _____.

Each of the above cost items stand alone, and when several items are selected there is double accounting and scale efficiencies. The total cost should not exceed the following estimates unless there are unusual and significant site characteristics. Significant impacts can drive costs up 5 to 10 times the following totals.

Small	Medium	Large	
$50,000	$150,000	$500,000	_____.

Enter total or revised total on 1.0, Summary Cost Estimate

REFERENCE: (USBM, 1986)

2.0 UNDERGROUND MINE CLOSURE

Choose only applicable closures, fill-in blanks as indicated, and total cost estimates.

Cost

2.1 Backfill adits.

Fill-in number of adit openings:

(_____ openings x $3 500/opening) = _____.

2.2 Backfill shafts and stopes.

Estimate total volume of openings, and fill-in applicable blank.

Less than 100 cu yd:

(_____ cu yd x $26/cu yd) = _____.

More than 100 cu yd:

(_____ cu yd x $10/cu yd) = _____.

2.3 Blast adit and shaft.

Fill-in number of adit and shaft openings:

(_____ openings x $3 200/opening) = _____.

2.4 Cast-in-place concrete cap shaft.

Fill-in number of shaft openings:

(_____ openings x $8,000/opening) = _____.

2.5 Precast concrete cap shaft.

Estimate number of 5 x 10 ft panels, and fill-in cost formula:

$\text{Panel Rows} = \text{SUM}_i[\text{INT}(\text{length}_i/10 + 1)]$
$\text{Panel Columns} = \text{SUM}_i[\text{INT}(\text{width}_i/5 + 1)]$
$\text{Total Panels} = \text{Panel Rows} \times \text{Panel Columns}$
where: INT - round to next whole panel.
i - index for the number of openings.

(_____ panels x $900/panel) = _____.

For openings with the largest dimension greater than 8 ft, estimate length of steel support beams, and fill-in cost formula:

Total Beams = Panel Rows x (Panel Columns x 5 + 2)

(_____ ft x $50/ft) = _____.

2.6 Monolithic plug shaft and stopes.

Estimate volume of riprap:

(_____ cu yd x $46/cu yd) = _____.

Estimate volume of concrete cap:

(_____ cu yd x $150/cu yd) = _____.

Estimate volume of backfill:

(_____ cu yd x $26/cu yd) = _____.

2.7 Steel grated shafts and adits.

Estimate total area of grating, and fill-in applicable blank.

For standard grates:

(_____ sq ft x $60/sq ft) = _____.

For bat grates:

(_____ sq ft x $80/sq ft) = _____.

2.8 Cable net shafts and adits.

Estimate total area of netting:

(_____ sq ft x $11/sq ft) = _____.

2.9 Polyurethane foam (PUF) shaft.

Estimate total PUF volume:

(_____ cu yd x $300/cu yd) = _____.

2.10 Bulkhead adits.

Fill-in number of openings, as applicable.

For openings up to 8 x 8 ft:

(_____ openings x $2 200/opening) = _____.

For larger openings up to 15 x 15 ft:

(_____ openings x $4,000/opening) = _____.

TOTAL -------> _____.

Enter total on 2.0, Summary Cost Estimate

REFERENCES: (CMLRD, 1989) (Essington, 1988)

3.0 SURFACE MITIGATION

Cost

3.1 Reshaping highwalls and roads.

Estimate area of clearing and grubbing, and fill-in applicable blank.

For dense vegetation cover (woodlands):

(_____ acres x $1 500/acre) = _____.

For moderate vegetation cover (small trees, shrubs):

(_____ acres x $1,000/acre) = _____.

Estimate volume of earthmoving including topsoil removal, and fill-in applicable blank.

For small jobs less than 10,000 cu yd, machine productivity is not relevant. Estimate number of days on site and multiply by daily rental rate:

$Sum_i[(\_\_\_\_\_ \text{ days x daily rate}_i)]$ = _____.

where: i is index for cost item.
daily rate = $250/day, backhoe or truck.
$350/day, dozer or loader.
$165/day, operator.

For medium sized jobs from 10,000 to 100,000 cu yd., estimate total volume of earthmoving:

(_____ cu yd x $2.40/cu yd) = _____.

For large jobs greater than 100,000 cu yd., estimate total volume of earthmoving:

(_____ cu yd x $2.00/cu yd) = _____.

If drilling and blasting is required, estimate the volume:

(_____ cu yd x $1.15/cu yd) = _____.

If lime treatment is required, estimate liming rate (see Table VIII, Tab IV) and acres:

(_____ lb/acre x _____ acres x $0.12/lb) = _____.

3.2 Waste dump stabilization.

If dump is relocated in a natural drainage channel, cost a French drain. Estimate volume of channel:

(_____ cu yd x $46/ cu yd) = _____.

If dump is relocated or volume of earthmoving is under 10,000 cu yd, use 3.1 for cost estimate.

For reshaping dump, estimate volume of earthmoving and fill-in applicable blank:

For medium jobs from 10,000 to 100,000 cu yd:

(_____ cu yd x $1.00/cu yd) = _____.

For large jobs greater than 100,000 cu yd.:

(_____ cu yd x $0.70/cu yd) = _____.

If lime treatment is required, estimate liming rate (see Table VIII, Tab IV) and acres:

(_____ lb/acre x _____ acres x $0.12/lb) = _____.

3.3 Mine drainage control.

Estimate volume of flow.

For flow less than 20 gpd, treat with limestone barriers or other simple neutralizing structures which can cost up to $20,000. _____.

For greater flows, a treatment plant can cost from $500,000 and up to build, and also incurs annual operating and maintenance costs. Get help.
[Should we substitute the USBM cost formula?]

3.4 Subsidence mitigation.

For reshaping and backfilling subsidence, estimate 1) volume of earthmoving 2) length of French drains, and 3) lime treatment, and calculate cost under 3.1.

Foundation support and subsurface reinforcement range in cost from $1,000 to $80 million. These items are beyond the scope of this handbook. Get help.

3.5 Mine fires.

A typical cost for extinguishing seam and dump fires is $500,000. This item is beyond the scope of this handbook. Get help.

3.6 Structures and equipment.

Assuming mechanical demolition, estimate volume of structures and equipment:

(_____ cu ft x $0.20/cu ft) = _____.

Locate a landfill, get a quote for transportation and disposal:

(_____ cu ft x $_____/cu ft) = _____.

TOTAL -------> _____.

Enter total on 3.0, Summary Cost Estimate

REFERENCES: (Cloues, 1991) (USBM, 1987) (USOTA, 1986)

4.0 EROSION AND SEDIMENTATION CONTROL

Cost

4.1 Hillslope erosion control.

For reshaping, water diversion, and water dispersion on large projects using earthmoving equipment, estimate volume of earthmoving:

(_____ cu yd x $1/cu yd) = _____.

Caution: Do not double account costs. This cost is not applicable in areas where costs already have been estimated for 3.1 Reshaping Highwalls and Roads, and 3.2 Waste Dump Stabilization.

4.2 Riprap drop structures.

Estimate volume of earthmoving:

(_____ cu yd x $2.40/cu yd) = _____.

Estimate length and cross sectional area of riprap:

(_____ yd long x _____ yd^2 area x 2.3 tons/cu yd x $20/ton) = _____.

4.3 Geologic drop structures.

Estimate volume of earthmoving:

(_____ cu yd x $2.40/cu yd) = _____.

If drilling and blasting is required, estimate volume:

(_____ cu yd x $1.15/cu yd) = _____.

4.4 Diversion ditches.

Estimate total length of diversion ditches:

(_____ ft x $1.25/ft) = _____.

Estimate area of jute matting and grass lining:

(_____ acres x $1 100/acre) = _____.

Estimate volume of riprap:

(_____ cu yd x $46/cu yd) = _____.

4.6 Culverts

Estimate number, size and cumulative length of culverts and fill in the following blanks. Cost assumes corrugated metal culvert, and includes culvert, headwall, end section, and installation.

30 in. diameter
_____ ea x $1,100 + _____ ft x $32/ft = _____.
36 in. diameter
_____ ea x $2,300 + _____ ft x $38/ft = _____.
42 in. diameter
_____ ea x $2,800 + _____ ft x $44/ft = _____.
48 in. diameter
_____ ea x $3,100 + _____ ft x $51/ft = _____.
54 in. diameter
_____ ea x $3,700 + _____ ft x $58/ft = _____.

4.7 Sedimentation and treatment basins.

Estimate volume of embankment:

(_____ cu yd x $1.50/cu yd) = _____.

If the basin requires a liner, estimate area of basin up to freeboard level. For basins up to 2.5 acres:

(_____ acres x $40,000/acre) = _____.

For larger basins up to 25 acres:

(_____ acres x $30,000/acre) = _____.

Estimate volume of riprap at spillway:

(_____ cu yd x 2.3 tons/cu yd x $20/ton) = _____.

4.8 Handbuilt hillslope structures.

Estimate length of structures.

Trenches and ditches:

(_____ ft x $0.50/ft) = _____.

Waterbars:

(_____ ft x $3.00/ft) = _____.

Whattling and ravel catchers:

(_____ ft x $5.00/ft) = _____.

4.9 Handbuilt drop structures.

For rock armour, estimate cover area.

If rock armour is placed without securing:

(_____ ft^2 x \$0.50/ft^2) = _____.

If rock armour is placed with securing:

(_____ ft^2 x \$2.50/ft^2) = _____.

For checkdams, estimate number:

(_____ checkdams x \$25 each) = _____.

TOTAL -------> _____.

Enter total on 4.0, Summary Cost Estimate.

REFERENCES: (USBM, 1986) (Weaver et al, 1987)

5.0 REVEGETATION

Cost

5.1 Topsoil replacement.

If topsoil is replaced from one area directly to another area without temporary stockpiling, only topsoil removal costs are incurred and there is no additional expense for topsoil replacement.

If topsoil is replaced from a stockpile, estimate volume:

(_____ cu yd x $1.50/cu yd) = _____.

5.2 Fertilization and seedbed preparation.

If fertilization is required, estimate area:

(_____ acres x $200/acre) = _____.

If irrigation is required, estimate sprinkler system:

(_____ acres x $15,000/acre) _____.

If lime requirements have not been estimated under 3.1 or 3.2, estimate liming rate (see Table VIII, Tab IV) and acres:

(_____ lb/acre x _____ acres x $0.12/lb) = _____.

5.3 Seeding and transplanting.

Estimate area of seeding and choose one of the following methods:

Broadcast -- $500/acre
Drill -- $1 200/acre
Hydroseeding -- $1 900/acre (includes mulch)

(_____ acres x $_____/acre) = _____.

For transplanting, decide on number of trees and shrubs per acre:

(_____ acres x _____ plants/acre x $2/plant) = _____.

5.4 Mulching.

Hydromulch is included in hydroseeding, 5.3.

For all other mulches, estimate area of application:

(_____ acres x $200/acre) = _____.

TOTAL -------> _____.

Enter total on 5.0, Summary Cost Estimate.

6.0 REGIONAL ADJUSTMENT

Two adjustments must be made to construction costs for the project location. First, the costs are adjusted for regional location based on the city cost indexes given by R.S. Means Company (1990, p. 316). This adjustment must be revised annually with publication of the latest city cost indexes. Second, the costs must be revised for remoteness of the project. Above costs assume that construction services and materials are within 50 miles of the project site. From the description given below, choose the appropriate remoteness factor.

6.1 Regional Adjustment.

Choose the applicable regional adjustment factor from the following list and fill in the first blank in the formula of 6.3.

	Region Factor
Mid Atlantic States	0.97
Mid West States	1.00
North Central States	0.92
Southern States	0.95
Rocky Mountain States	1.02
Intermountain States	0.95
West Coast States	1.05
Alaska	1.45

6.2 Remoteness Adjustment

Choose the site description that most nearly matches the project site and fill in the given remotness factor in the second blank in the formula of 6.3.

From a labor pool and source of construction materials, the site is:	Remote Factor
Less that 50 miles away.	1.00
Readily accessible by road, and is from 50 to 200 miles away. (Includes Fairbanks area.)	1.30
More that 200 miles away or the last 25 to 50 miles is overland from the nearest road. (Includes South Alaska.)	1.45
Accessible only on foot or by	1.65

helicopter. Only valid for handbuilt construction (Includes Central Alaska below the Artic Circle.)

6.3 Total Regional Adjustment.

(_____ Subtotal #1 x _____ Region Factor x _____ Remote Factor) = _____.

6.4 Helicopter Support.

If required, check local rates for helicopter services and capacity to the project site. Estimate the number of trips.

(_____ trips x $_____/trip) = _____.

TOTAL -------> _____.

Enter amount on 6.0, Summary Cost Estimate.

7.0 COST INFLATION

The unit costs given in this handbook are current as of spring 1991. These unit costs can be updated for the effect of cost inflation with indices provided by the U.S. Bureau of Labor Statistics. To adjust costs for a future year, multiply the handbook cost times the index, I, for the future year divided by the index for 1991.

For the labor index, I_L, use Employment and Earnings C-1 Construction.

For the equipment index, I_E, use 112 Construction Machinery and Equipment.

Cost

Apply the adjustment only to items 2.0 through 6.0, and assume that costs components are 60% equipment and 40% labor:

[(0.6 x ____ I_E/1991 I_E) + (0.4 x ____ I_L/1991 I_L)]

x _____ Regional Adjusted Subtotal = _____.

Enter amount on 7.0, Summary Cost Estimate.

8.0 ENGINEERING AND DESIGN

Engineering and design fees typically range from 10 to 20 percent of total project construction costs exclusive of mobilization, contingency, and project overheads (construction and project management). Contingency allowance must cover any additional engineering.

Because the engineering and design for AML projects is straightforward and can be standardized, use the low end of this cost factor, 10 percent.

9.0 MOBILIZATION

Estimate mobilization at $1 500 per major item of earthmoving equipment. Include items such as blast hole drills, dozers, loaders, and trucks larger than 30 ton capacity. Do not include items such as service trucks, vans, and compressors Total mobilization allowance should not exceed 15% of construction cost (Line 7.0).

Cost

(_____ units x $1 500/unit) = $

or

($_____ Subtotal #3 x 0.15) = $

Choose lower amount = _____.

Enter total on 9.0, Summary Cost Estimate.

10.0 CONSTRUCTION MANAGEMENT

Construction management fees are not applicable for projects valued under $500,000. Construction management for larger projects is typically 1.5% of construction costs, Line 7.0.

Cost

0.015 x ($_____ Subtotal #3) = _____.

Enter amount on 10.0, Summary Cost Estimate

11.0 NPS PROJECT MANAGEMENT

Cost

11.1 Salaries.

(staff x average salary/yr x duration in yr)

(_____ staff x $_____/yr x _____ yr) = _____.

11.2 Payroll burden and fringe benefits.

(item 11.1 x benefit allowance)

($_____ x 0.____) = _____.

11.3 Administrative supplies and equipment.

Estimate requirements for communications, small tools, postage, computer services, office supplies, etc. _____.

11.4 Site visits.

(number of visits x miles x mileage rate)

(_____ visits x _____ mi x $0.____/mi) = _____.

(visits x days/visit x per diem)

(____ visits x ____ days/visit x $_____/day)= _____.

11.5. Other expenses. _____.
[annual maintenance costs]

TOTAL -------> _____.

Enter total on 11.0, Summary Cost Estimate.

12.0 CONTINGENCY

	No Experience	Previous Experience
Preliminary Design	25%	15%
Definitive Engineering	15%	10%
Contract Bid	10%	5%

Cost

(Line 7.0 x Contingency Rate) = Contingency

(_____ x _____) = _____.

Enter amount on 12.0, Summary Cost Estimate

13.0 MONITORING MAINTENANCE

Cost

13.1 Water sampling.

Decide on the number of site visits per year. Each site visit includes surface water and groundwater sampling, and chemical analysis. The groundwater sample requires pumping out standing water.

(_____ sample sites x _____ samples/yr x $500/sample) = _____.

Recalculate for each year as required for changes in number of sample sites or samples per year and enter amount on line 13.0, Annual Maintenance Cost.

14.0 REVEGETATION MAINTENANCE

Cost

14.1 Fertilization.

Generally, areas with more than 12 in. of topsoil only require one follow-up application of fertilizer. Less topsoil may require up to 4 applications over a 6 to 8 year period.

Estimate area requiring fertilization:

(_____ acres x $100/acre) = _____.

14.2 Irrigation.

Estimate area requiring irrigation:

(_____ acres x $3,000/acre) = _____.

TOTAL -------> _____.

Recalculate for each year as required for changes in fertilization and irrigation, and enter total on line 14.0, Annual Maintenance Cost.

REFERENCE: (USBM, 1986)

15.0 NPS MAINTENANCE MANAGEMENT

Monitor sites based on environmental conditions, type of closure, and number and type of visitors.

Weekly or daily for heavily visited sites with numerous potential hazards.

Weekly, monthly, or quarterly for sites that have been closed temporarily and receive numerous visitors.

Every 3 to 5 years for remote, permanently closed sites.

After winter, heavy precipitation, or winds and before numerous visitors until closed sites have stabilized.

Cost

15.1 Salaries.

(staff x average salary/yr x duration)

(_____ staff x $_____/yr x _____ yr) = _____.

15.2 Payroll burden and fringe benefits.

(item 15.1 x benefit allowance)

($_____ x 0.____) = _____.

15.3 Administrative supplies and equipment.

Estimate requirements for communications, small tools, postage, computer services, office supplies, etc. _____.

15.4 Site visits.

(number of visits x miles x mileage rate)

(_____ visits x _____ mi x $0.____/mi) = _____.

(visits x days/visit x per diem)

(____ visits x ____ days/visit x $_____/day)= _____.

15.5. Other expenses. _____.

TOTAL -------> _____.

Recalculate for each year as required for changes in monitoring schedule, and enter total on line 15.0, Annual Maintenance Cost.